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Short Paper

Effectiveness of Collaborative Learning Strategy on Undergraduate Science Education Students' Achievement in Laboratory Organization and Management in Nigerian Universities

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Abstract

Laboratory organization and management are common practical aspect of science education. It is a sine qua non in teaching science but it seemed that science education undergraduate students were not exposed to this practical aspect of science. Hence, this study tried to investigate the effectiveness of collaborative learning strategy on science education undergraduate students' achievements in laboratory organization and management in Nigerian universities. Two research questions were posed and two null hypotheses were formulated to guide the study. A quasi-experiment of the non-equivalent control group design was used in the study. Purposive sampling technique was used to select only Federal Government owned universities from the Southeast that had been accredited and admitted undergraduate students into science education department of faculty of education for at least five years. Science education departments of faculty of education of federal universities were selected as ideal place for the study. The sample for the study is two hundred and fifty-five (255)

undergraduate science education students. Multi-stage random sampling and simple random sampling techniques were applied. The test instrument named science education undergraduate students' achievement in laboratory organization and management in Nigerian universities (SEUSALOMNU) was developed and adopted by the researchers. The instrument was subjected to face and content validity by two experts from Nigerian universities. Data were analyzed using mean, standard deviation and ANCOVA. The result showed that the collaborative learning method (CLS) promotes high academic achievement in laboratory organization and management than the lecture method (LM). It was recommended among others that undergraduate science education students should be encouraged to study in smaller groups which would help in exchange of knowledge, and ideas, fast learning and encourage teamwork.

Keywords – collaborative learning strategy, undergraduate science education students, achievement

INTRODUCTION

Education is the key to life. It deals with the process of building, training and developing the inborn potentials and capabilities of the individual learner to make him a useful member of society. Duru (2021) views education as a necessity for individuals at any level in life notwithstanding the age at which the learner upholds the knowledge. It is the weapon against poverty, ignorance and societal crises. The Education system in most nations today comprises primary, secondary and tertiary levels. The tertiary level is otherwise known as higher education.

Higher education is education for people in colleges, universities and vocational institutions. World Bank (2022) defined tertiary-higher education as all formal post-secondary education including public and private universities, colleges, polytechnics, technical training institutes and vocational schools. It is instrumental in fostering growth, reducing poverty and boosting shared prosperity. Olisaemeka (2021) added that higher education is a critical component in sustainable human and natural development. It is axiomatic that no nation ever develops technologically and economically without first investing heavily in its higher education. World Bank (2022) points out that tertiary education is instrumental in fostering a nation's growth and development, reduces poverty, and inculcates relevant knowledge and advanced skills. It also provides human resources required for leadership, management, business and professional positions.

With regards to the aforementioned benefits of tertiary education to human and society, Nigeria's tertiary education has been interrupted by regime changes since its independence. All those regime changes embarked on policies towards sustaining unity, transformation and economic growth. The stated policies were not implemented and so could be attributed to learners' slit average achievement and poor method of teaching in tertiary institutions in Nigeria.

Teaching methods are important strategies or techniques that a teacher uses in performing his or her basic function of teaching. Some of the teaching methods are collaborative, cooperative, demonstration, lecture, discussion and so on. Collaborative learning strategy (CLS) is an essential objective strategy - a method of teaching-learning that transforms the traditional or teacher-dominated classroom into students centred classroom in the form of a peer-to-peer learning environment. Owoyemi (2018) defined collaborative learning strategy (CLS) as a strategy-method-technique in which students team together to explore a significant question or create a meaningful project. This learning strategy shares many of the same traits as the cooperative learning strategy. Similarly, Bhowmik in Achufusi-Aka and Okpanachi (2021) added that CLS allows small groups of students to work jointly by sharing knowledge to enhance their knowledge of a subject matter. In this aspect, individual achievement is de-emphasized while teamwork is promoted. Furthermore, groups plan to learn activities together, carry out their action plans and present a complete project, display or report to the class and graded their work as a team (Galvin in Ogbonne & Offorma, 2013). Thus, in collaborative learning situations, students are not simply taking in information or ideas rather they are creating something new with the information and ideas. These acts of intellectual processing of meaning or creating something new are crucial to learning which could be linked to Bandura's theory of learning.

LITERATURE REVIEW

Bandura's theory of learning which is among the social learning theory was developed by Bandura in 1977. The theory states that people could learn to behave in certain ways by observation and imitation of behaviours and the outcome of such behaviours. Bandura (1977) emphasized the importance of observing or modelling or imitating behaviours, attitudes and emotional reactions of others. As for Bandura, learning would be exceedingly laborious if people had to rely solely on the effects of their actions to inform them what to do. Hence, CLS provides a driving force for social learning theory where undergraduate science education students are in control of their learning and ultimately, the outcome of their learning. CLS is more concerned with a specific outcome based on teacher facilitation and transmission of knowledge. The implication of Bandura's theory presents CLS as promoting values such as social interaction-communication, honesty, cooperation, mutual respect, responsibility, tolerance, willingness to sacrifice a consensus, self-confidence in students, promotes deep learning of materials and as well helps students to achieve better grades.

Achievement is defined as an act of finishing something successfully. Ogoke, Otumegwu and Nwaneri (2022) defined achievement as the act of accomplishing something, especially through exertion, skill, practice or perseverance. It is not only reaching greater heights but also getting something after a bit of struggle. Relating this to academic achievement in this context means success in acquiring science process skills, knowledge, and attitudes towards the use of laboratory equipment – apparatus and manipulation of laboratory equipment when CLS is used in the teaching-learning process.

Achievement in science education is an important variable that expresses the success or failure of a teaching-learning process. Academic achievement can be referred to as a measure of students' knowledge, skills, abilities and aptitude which the undergraduate science education students have learnt through standardized test scores or grades offered by the lecturer.

Science education is important in a nation's curriculum. It is a means for equipping undergraduate science education students to live effectively in the modern age of science and technology. It is also important to the growth and development of any nation and crucially so in Nigeria, which is at present a basic consumer of scientific-technological inventions. Achufusi-Aka and Okpanachi (2021) described science education as a body of knowledge systematically arranged with scientific and technological principles, themes and contents. It has the potential for helping the development of individual learners towards having the abilities of understanding science, scientific activities and its applications (Giovanni, 2021). It centres on teaching and learning natural science, issues in science, scientific concepts and theories. It is a department of its own in tertiary institutions – colleges that nurture, train, equip, develop and educate learners on pedagogies, science process skills, and scientific and technological principles. As a department of its own, it anchors a series of options – subject attachments depending on the institution. Such subject attachments include; Biology Education, Mathematics Education, Chemistry Education, Integrated–Basic Science Education, Computer Education and Physics Education. Each of these subject attachments is related to each other in the aspect of the curriculum - content development and knowledge impact. It equally prepares graduates from science education on appropriate methods to apply while teaching, effective implementation of curriculum and application of science in our daily lives.

The emphasis of science education teaching and learning in Nigeria tertiary institutions by researchers, stakeholders and science educators is on undergraduate science education students' scientific literacy, scientific knowledge, attitude and knowledge of science process skills which when taught effectively would enable undergraduate science education students to lead a fulfilling and responsible life by encouraging themselves to learn independently, deal with new situations, reason critically, think creatively, make informed decisions and solve problems. Hence, the problem of this study is to empirically explore the effectiveness of collaborative learning strategy on science education undergraduate students' achievement in laboratory organization and management in Nigerian universities.

STATEMENT OF THE PROBLEM

The paper examined how two different teaching methods – approaches, the lecture method (LM) and collaborative learning strategy (CLS) affected the learning that occurred. It explored these two methods of teaching in the Nigerian University context by examining the past students' results in laboratory organization and management from 2018 – 2021 in various tertiary institutions. Unfortunately, available departmental examiners' (DER) reports from the stated years revealed the average achievement of undergraduate science

education students in the course. Departmental examiners' report attributed the cause of the undergraduate science education students' achievement to overcrowding of students at the lecture hall, distractions of students which was associated with overcrowding, students' lack of knowledge of the subject matter, poor handwriting, spelling mistakes, lack of interest, non-commitment and poor method of teaching on the part of the teacher. Poor method of teaching could be a result of continuous use of lecture method – conventional method of teaching in the lecture hall-classroom. Hence, this study tried to find out how CLS could affect academic achievement and maximize learning opportunities. Also, the study set out to find out a way to end up the debate among different lecturers about how these two different methods influence academic achievement by documenting and publishing the benefits that might accrue to students who interact with others. This study sought to ask for great concern and a change in the education system due to the various challenges Nigeria as a country are facing from 2015 to the present day.

PURPOSE OF THE STUDY

The main purpose of this study was to investigate the effectiveness of collaborative learning Strategy on science education undergraduate students' achievement in laboratory organization and management in Nigerian universities. Specifically, the study sought to examine the following;

- The difference in the mean achievement scores of science education undergraduate students taught laboratory organization and management using CLS and those taught with LM.
- The difference in the mean achievement scores of male and female science education undergraduate students taught laboratory organization and management using CLS.

RESEARCH QUESTIONS

The following research questions guided the study;

1. What is the difference in the mean achievement scores of science education undergraduate students taught laboratory organization and management using CLS and those taught with LM?
2. What is the difference in the mean achievement scores of male and female science education undergraduate students taught laboratory organization and management using CLS?

HYPOTHESES

The following null hypotheses were formulated and tested at a 0.05 level of significance.

Ho_1: There is no significant difference in the mean achievement scores of science education undergraduate students taught laboratory organization and management using CLS and those taught with LM.

Ho_2: There is no significant difference in the mean achievement scores of male and female science education undergraduate students taught laboratory organization and management using CLS

METHODOLOGY

The method involved non-randomized two groups of intact classes made up of control and experimental groups. Therefore, the research design adopted for this study was quasi-experimental since intact classes were used. The researchers studied the effect of the method on intact classes rather than randomly assigning participants to the experimental or control groups because complete randomization of the subjects was not possible. Hence, a pre-test was administered at the beginning of the study and the post-test data were used to determine whether the subjects in different groups were homogeneous or not.

The target population was made up of all Nigerian University undergraduate science education students. Thus, the purposive sampling technique was used to select only Federal Government owned universities from the Southeast that had accredited and admitted undergraduate students into the science education department of the faculty of education for at least five years. Science education departments of faculty of education of federal universities were selected as ideal places for the study. This is because of the following; they are being funded by the federal government, they all have the same admission policy, they have the same school fees range, same promotion policy and staffing. This could have resulted in the high enrollment of both undergraduate and postgraduate students in federal universities in Nigeria. The sample for the study was two hundred and thirty (230) undergraduate science education students. Multi-stage random sampling and simple random sampling techniques were applied. Two federal universities in the southeast that had accredited and admitted undergraduate students into the science education department of faculty of education for at least five years were adopted for the study. Also, four options out of six options in science education programs were selected from each and two selected higher institutions. One intact class each was selected from the sample size. Hence, 156 university undergraduate science education students were assigned to the experimental group and 74 university undergraduate science education students were assigned to the control group and used for the study. 156 university undergraduate science education students in the experimental group were taught using collaborative learning (CLS) and the 74 university undergraduate science education students in the control group were taught using the lecture method (LM) in the institutions.

The instrument was developed by the researchers through careful study of past examinations on laboratory organization and management set by the department. Questions were generated from past questions and were adopted for the study. The test instrument aimed to evaluate undergraduate science education students' academic

achievement after the content had been taught to them. The test instrument named science education undergraduate students' achievement in laboratory organization and management in Nigerian universities (SEUSALOMNU) consisted of 40 objective questions. The instrument was subjected to face and content validity by two experts from the science education departments of Odumewu Ojukwu University, Uli campus, Anambra State, Nigeria and Imo State University, Owerri, Nigeria. After scrutiny, they recommended the modification of the instruments and identified the exclusion of some items not relevant to the study. The corrections made reduced the test items to forty (40) for the instrument. The contents of the test items were found to be within the ability level of Nigerian university undergraduate science education students, free from any ambiguities and have covered the study area. It also means that the instrument was able to measure the intended area of the study. Split-half reliability estimation was used in calculating the reliability coefficient of the instrument. SEUSALOMNU has a reliability coefficient of 0.79. In the beginning, the groups were pre-tested and after treatment, the groups were subjected to post-test. Research questions were answered using means and standard deviation (SD), while hypotheses were tested using Analysis of Covariance (ANCOVA).

RESULTS

Data were analyzed and presented according to research questions and hypotheses.

Research Question 1: What is the difference in the mean achievement scores of science education undergraduate students' taught laboratory organization and management using CLS and those taught with LM?

Table 1. Mean and Standard Deviation scores of Experimental and Control Groups

		Pre-test			Post-test		
Groups	**N**	**$\bar{X}$**	**SD**	**$\bar{X}$ Difference**	**$\bar{X}$**	**SD**	**Gain Score**
Exp.Group	156	13.53	3.64		19.14	3.55	5.61
Control Group	74	12.93	4.65	1.01	13.86	4.55	0.93

Table 1, it showed that the mean scores of the experimental group were 13.53 in the pre-test and 19.14 in the post-test with a standard deviation of 3.64 and 3.55. The control group of science pre-service teachers' obtained mean scores of 12.93 and 13.86 in the pre-test and post-test. Their standard deviations were 4.65 and 4.54. The table shows that the experimental group had higher mean gain scores of 5.61 than the control group which had a gain score of 0.93.

Research Question 2: What is the difference in the mean achievement scores of male and female science education undergraduate students' taught laboratory organization and management using CLS?

Table 2 points out that the male had 10.42 and 11.24 in their pre-test and post-test respectively with a mean gain of 0.82. The standard deviations were 3.26 and 3.48. The females had mean achievement scores of 9.83 and 10.96 in the pre-test and post-test. The result indicates that males in the experimental group had slightly higher mean achievement scores than the female taught using a collaborative learning strategy (CLS). However, the difference appears not to be substantial.

Table 2. Mean and Standard Deviation scores of male and female science pre-service teachers' taught laboratory organization and management using CLS

		Pre-test			Post-test		
Groups	**N**	**Ẍ**	**SD**	**Ẍ Difference**	**Ẍ**	**SD**	**Gain Score**
Male	116	10.42	3.26		11.24	3.48	0.82
Female	114	9.83	3.89	0.59	10.96	4.00	1.13

Hypotheses

For the method of teaching, the f-cal value of 4.22 is greater than the f-table value of 3.89. There is a significant difference between the mean achievement scores of science pre-service teachers taught laboratory organization and management using CLS and those taught using LM.

Ho_1: There is no significant difference in the mean achievement scores for science education undergraduate students' taught laboratory organization and management using CLS and those taught with LM.

Table 3. ANCOVA results of science education undergraduate students' taught laboratory organization and management using CLS and those taught with LM**.**

Source of Variation	**Sum of squares**	**Df**	**Mean squares**	**f-cal**	**f-crit**	**Decision**
Covariance	269.9476	1	269.9476	1.24	3.89	NS
Main effect	917.0862	1	917.0862	4.22	3.89	S
Method	9170862	1	917.0862	4.22	3.89	S
Explained	1208.8294	2	604.4147			
Residual	5150.4603	227	217.3190			
Total	6359.2897					

Data in Table 4 shows that for the covariate (pre-test), the f-cal value of 2.22 is less than the f-table value of 3.89. Hence covariate is not significant. For the method, the f-cal value of 1.06 is less than the t-table value of 3.89. This implies not significant, so the null hypothesis of no significant difference is accepted. Therefore, there is no significant

difference between the mean scores of males and females taught laboratory organization and management using CLS.

Ho_2: There is no significant difference in the mean achievement scores of male and female science education undergraduate students' taught laboratory organization and management using CLS.

Table 4. ANCOVA results of Male and Female science education undergraduate students' taught laboratory organization and management using CLS

Source of Variation	Sum of squares	Df	Mean squares	f-cal	f-crit	Decision
Covariate pre-test	138.5859	1	138.5859	2.22	3.89	NS
Main effect	66.1717	1	66.1717	1.06	3.89	NS
Gender	66.1717	1	66.1717	1.06	3.89	NS
Explained	249.8416	2	124.9208			
Residual	14794.9857	227	62.4261			
Total	15044.8239					

DISCUSSION

The learning outcome in Table 1 and 3 shows that the mean achievement scores of science education undergraduate students' taught with CLS was higher than those taught with LM. The difference in the mean achievement scores between the experimental group taught with CLS and the control group taught with LM was shown to be significant as presented in the ANCOVA result in Table 3. The significant enhancement of achievement in laboratory organization and management was due to CLS which was activity oriented and interactive. This result agrees with Ogbonne & Offorma (2013), Owoyemi (2018), and Achufusi-Aka and Okpanachi (2021) that an effective teaching method promotes students' high achievement in what is taught. The findings of this study support the assertion by Achufusi-Aka and Okpanachi (2021) that a collaborative learning strategy (CLS) enhances high learners' achievement and as well promotes open communication and sharing of ideas - knowledge among learners. This makes learning to be sustained and so could be used to ward off the stereotyped lecture method (LM) that has dominated Nigerian classrooms.

The findings in Table 2 and 4 indicates that males in the collaborative learning strategy (CLS) had slightly higher mean achievement score than their female counterparts 11.24 and 10.96 respectively. However, the difference appears not to be substantial. The ANCOVA result in Table 4 reveals that the difference is not significant, f-cal = 1.06. This implies that gender is not a significant factor in science education undergraduate students' achievement. The findings of Oyarole and Adeola (2017) and Achufusi-Aka and Okpanachi (2021) agree with these research findings that a collaborative learning strategy is gender

friendly, efficacious in eliminating gender-related differences in learning and creates an equal opportunity for the students to learn together irrespective of their gender differences.

CONCLUSIONS AND RECOMMENDATIONS

From the study, it is concluded that LM can be used in the instructional process but CLS is found to be more effective than LM. CLS facilitates teamwork, group work, and hands-on and minds-on activities which lead to the higher achievement of undergraduate science education students and provides quality education. It promotes harmony among undergraduate science education students. CLS also revealed that with quality social interaction between science educators – students, student –students; undergraduate science education students could easily and freely manipulate laboratory equipment and possess science process skills as well.

Furthermore, in referring to the results of the study, some recommendations are given. Science education curriculum planners in National University Commission (NUC) should include collaborative ideas when planning for science education curricula. This could provide for meaningful classroom interaction patterns necessary for promoting academic achievement and quality education. Undergraduate science education students should be encouraged to study in smaller groups which could help the exchange of knowledge, ideas, fast learning and encouragement of teamwork. It would make undergraduate science education students familiar with their peers while still enjoying smaller group studies.

IMPLICATIONS

The educational implication of this study is very challenging. Sharing the students into groups to work together as a team or study in a group helps the students to become more serious and active in their classwork. It is a valuable strategy for helping students to attain high academic standards. But, allowing them to work alone may not help some of them attain a high academic standard. Another implication of the finding is that the adoption of collaboration can help students in peer tutoring which can lead to higher achievements. Weaker students working individually are likely to give up when they get bored. Working collaboratively as a team helps learners desire to learn more. More intelligent peers faced with the task of explaining and clarifying ideas and concepts to the weaker ones often find gaps in their understanding and construct more meaningful knowledge in the process.

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REFERENCES

Achufusi-Aka, N.N. & Okpanachi, E.E. (2021). Effect of collaborative learning strategy on students' academic achievement in chemistry in Onitsha education zone, Anambra State. *International Scholars Journal of Arts and Social Science Research, 3, Issue 3;* 182-189.

Bandura, A. (1977). *Social Learning Theory*. New York: General learning press. Retrieved on 13th April 2022 from https://www.instructionaldesign.org/theories/social-learning/.

Departmental Examiners Reviewers Report (2018-2021). *Examining the past students' results in laboratory organization and management*, Awka, Anambra State.

Duru, C.C. (2021). Impediments to effective utilization of funds in tertiary institutions. *UNIJERPS, 2;* 229-241.

Giovanni, O. (2021). *Science education: purpose, methods, ideas and teaching resources*. Retrieved on 15th April 2022 from interacademics.org/new/what-purpose-science-education

Ogoke, C.J., Otumegwu, T.U. & Nwaneri, O.M. (2022). Effect of peer tutoring on mathematics achievement of senior secondary school students in Owerri Municipal Council of Imo State. *SEJRSD, 6(2);* 17-33.

Ogbonne, U.T. & Offorma, G.C. (2013). Effect of collaborative learning method on secondary students' interest in English language tenses. *International Journal of Educational Research, 12 (2);* 128-135.

Olisaemeka, E.O. (2021). Tertiary education: Panacea for sustainable national transformation. *UNIJERPS, 2;* 186 -189.

Owoyemi, T.E. (2018). Effect of collaborative and competitive learning strategies on senior secondary students' academic achievement in environmental-related concepts in chemistry. *JSTAN, 53;* 54-67.

Oyarole, Y.A., & Adeola, A.D. (2017) Impact of small-group learning strategy on performance and retention in ecology among senior secondary school students in Gusau, Zamfara State, Nigeria. *ATBU, Journal of Science, Technology & Education (JOSTE); 5* (3);137-147.

World Bank (2022). *Tertiary education and skills (TES)*. Retrieved on 28th April 2022 from worldbank.org/en/topic/tertiaryeducation#1.